

RF TEST REPORT

Test item : G-PON ONT
Model No. : H640GW
Order No. : DEMC1304-01202
Date of receipt : 2013-04-03
Test duration : 2013-05-02~ 2013-05-13
Date of issue : 2013-06-04
Use of report : FCC Original Grant

Applicant : DASAN Networks Inc.
DASAN Tower, 49, Daewangpangyo-ro 644 Beon-gil, Bundang-gu,
Seongnam-si, Gyeonggi-do, Korea

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, 449-080, Korea

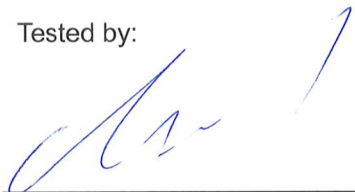
Test specification : FCC Part 15 Subpart C 247
KDB558074 v03r01

Test environment : See appended test report

Test result : Pass Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DIGITAL EMC CO., LTD.

Tested by:



Engineer
ChulMin Kim

Witnessed by:

N/A

Reviewed by:



Deputy General Manager
Hong-Hee Lee

Test Report Version

Test Report No.	Date	Description
DRTFCC1305-0497	May. 15, 2013	Initial issue
DRTFCC1305-0497(1)	Jun. 04. 2013	Description of the radiated emission test is revised.

Table of Contents

- 1. GENERAL INFORMATION 4**
- 2. EUT DESCRIPTION 4**
- 3. SUMMARY OF TESTS 5**
- 4. TEST METHODOLOGY 6**
 - 4.1 EUT CONFIGURATION 6
 - 4.2 EUT EXERCISE 6
 - 4.3 GENERAL TEST PROCEDURES 6
 - 4.4 DESCRIPTION OF TEST MODES 6
- 5. INSTRUMENT CALIBRATION 7**
- 6. FACILITIES AND ACCREDITATIONS 7**
 - 6.1 FACILITIES 7
 - 6.2 EQUIPMENT 7
- 7. ANTENNA REQUIREMENTS 7**
- 8. TEST RESULT 8**
 - 8.1 6dB Bandwidth 8
 - 8.2 Maximum Peak Conducted Output Power 21
 - 8.3 Maximum Power Spectral Density 23
 - 8.4 Conducted Spurious Emissions 37
 - 8.5 Radiated Spurious Emissions 86
 - 8.6 Power-line Conducted Emissions 92
 - 8.7 Occupied Bandwidth 95
- 9. LIST OF TEST EQUIPMENT 96**
- APPENDIX I 97**

1. GENERAL INFORMATION

Applicant : DASAN Networks Inc.
Address : DASAN Tower, 49, Daewangpangyo-ro 644 Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea
FCC ID : 2AAAQH640GW
EUT : G-PON ONT
Model : H640GW
Additional Model(s) : N/A
Data of Test : 2013-05-02 ~ 2013-05-13
Contact person : YangSik Ryu

2. EUT DESCRIPTION

Product	G-PON ONT
Model Name	H640GW
Power Supply	DC 12 V
Frequency Range	2.4GHz Band ▪ 802.11b/g/n(20MHz): 2412 ~ 2462 MHz ▪ 802.11n(40MHz): 2422~2452 MHz
Max. RF Output Power	2.4GHz Band ▪ 802.11b: 19.71dBm ▪ 802.11g: 23.59dBm ▪ 802.11n (HT20): 24.61dBm ▪ 802.11n (HT40): 21.95dBm
Modulation Type	802.11b: DSSS/CCK 802.11g/n: OFDM
Antenna Specification	Antenna type: Dipole Antenna Antenna gain: Chain 0 : 5.0dBi & Chain 1 : 5.0dBi Antenna configuration ▪ 802.11b/g: 1TX/2RX(MISO: TX = Chain 0) ▪ 802.11n(MCS0 ~ 7): 1TX/2RX(MISO), 2TX/2RX(MIMO) ▪ 802.11n(MCS8 ~ 15): 2TX/2RX(MIMO)

3. SUMMARY OF TESTS

FCC Part Section(s)	RSS Section(s)	Parameter	Limit	Test Condition	Status Note 1
I. Transmitter Mode (TX)					
15.247(a)	RSS-210 [A8.2]	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	RSS-210 [A8.4]	Transmitter Output Power	< 1Watt		C
15.247(d)	RSS-210 [A8.5]	Out of B and E missions / Band Edge	20dBc in any 100kHz BW		C
15.247(e)	RSS-210 [A8.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz		C
-	RSS Gen [4.6.1]	Occupied Bandwidth (99%)	RSS-Gen4.6.1		NA
15.205 15.209	RSS-210 [A8.5]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	<FCC 15.209 limits	Radiated	C
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	< FCC 15.207 limits	AC Line Conducted	C
15.203	-	Antenna Requirements	FCC 15.203	-	C
Note 1: C=Comply NC=Not Comply NT=Not Tested NA=Not Applicable Note 2: This test item was performed in each axis and the worst case data was reported.					

4. TEST METHODOLOGY

The measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2009) and KDB558074

4.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

4.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements of ANSI C63.4. (Version: 2009), conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turntable, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4. (Version: 2009)

4.4 DESCRIPTION OF TEST MODES

The EUT has been tested with several operating conditions for maximizing the emission characteristics. A test program is used to control the EUT for staying in continuous transmitting mode.

5. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

6. FACILITIES AND ACCREDITATIONS

6.1 FACILITIES

The open area test site(OATS) or semi anechoic chamber and conducted measurement facility used to collect the radiated and conducted test data are located at the 683-3, Yubang-Dong, Yongin-Si, Gyunggi-Do, 449-080, South Korea. The site is constructed in conformance with the requirements.

- Semi anechoic chamber registration Number : 678747

6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and peak, quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

7. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

*The external antenna cable of this E.U.T is uniquely attached on the PCB by soldering.

*Therefore this E.U.T Complies with the requirement of §15.203

8. TEST RESULT

8.1 6dB Bandwidth

Test Requirements and limit, §15.247(a)& RSS-210 [A8.2]

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6dB bandwidth is 500 kHz.

■ TEST CONFIGURATION

Refer to the APPENDIX I.

■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of KDB558074.

1. Set resolution bandwidth (RBW) = 100 KHz
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
(RBW:100KHz/VBW:300KHz)
3. Detector = **Peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

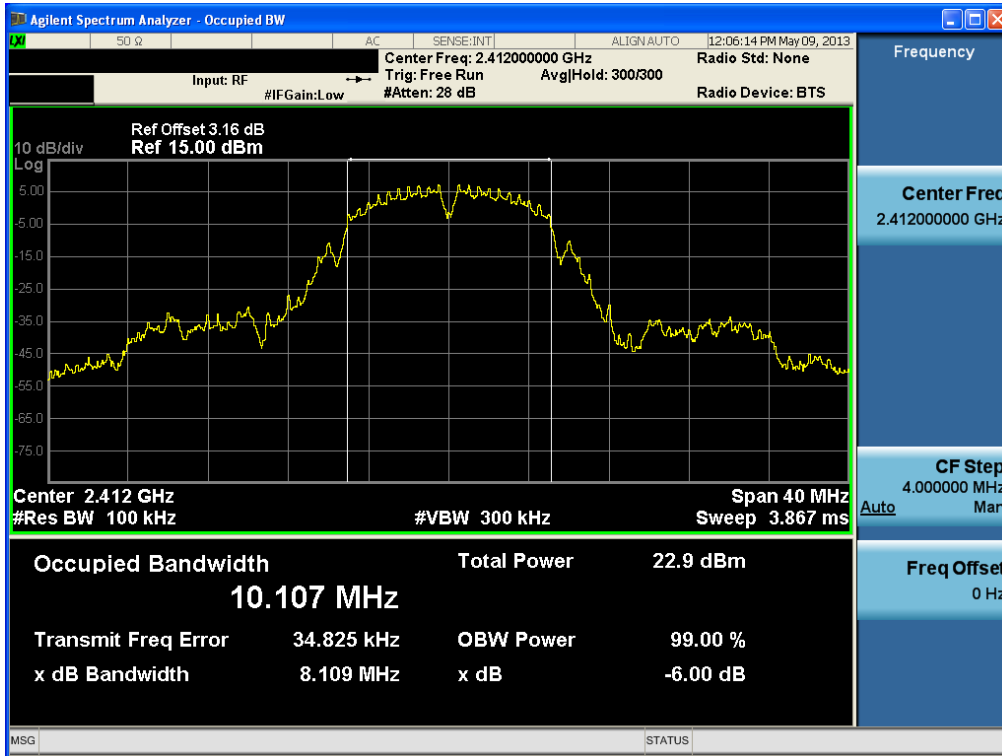
■ TEST RESULTS: **Comply**

Test Mode	Data Rate	Frequency [MHz]	Test Results[MHz]	
			Chain 0	Chain 1
802.11b	1Mbps	2412	8.109	N/A
		2437	8.132	N/A
		2462	8.117	N/A
802.11g	6Mbps	2412	15.100	N/A
		2437	15.000	N/A
		2462	15.050	N/A
802.11n (20MHz)	MCS 8	2412	15.070	15.170
		2437	15.120	15.120
		2462	15.120	15.110
802.11n (40MHz)	MCS 8	2422	35.180	35.200
		2437	35.240	35.240
		2452	35.160	35.230

RESULTPLOTS

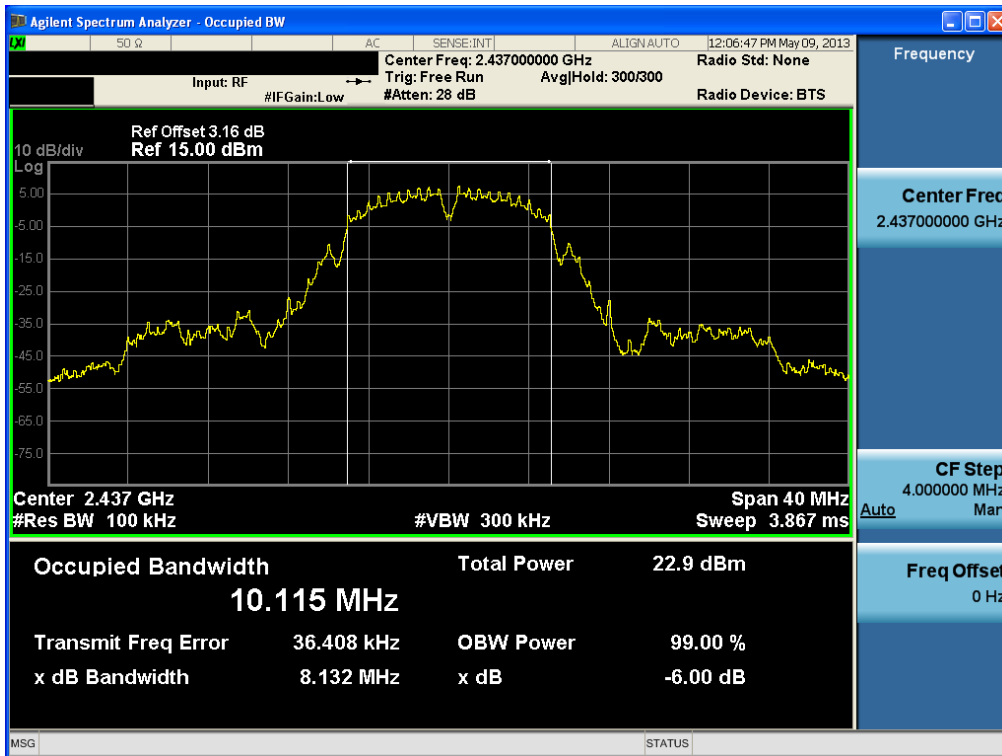
6 dB Bandwidth

Test Mode: Chain 0 & 802.11b & 1Mbps & 2412MHz



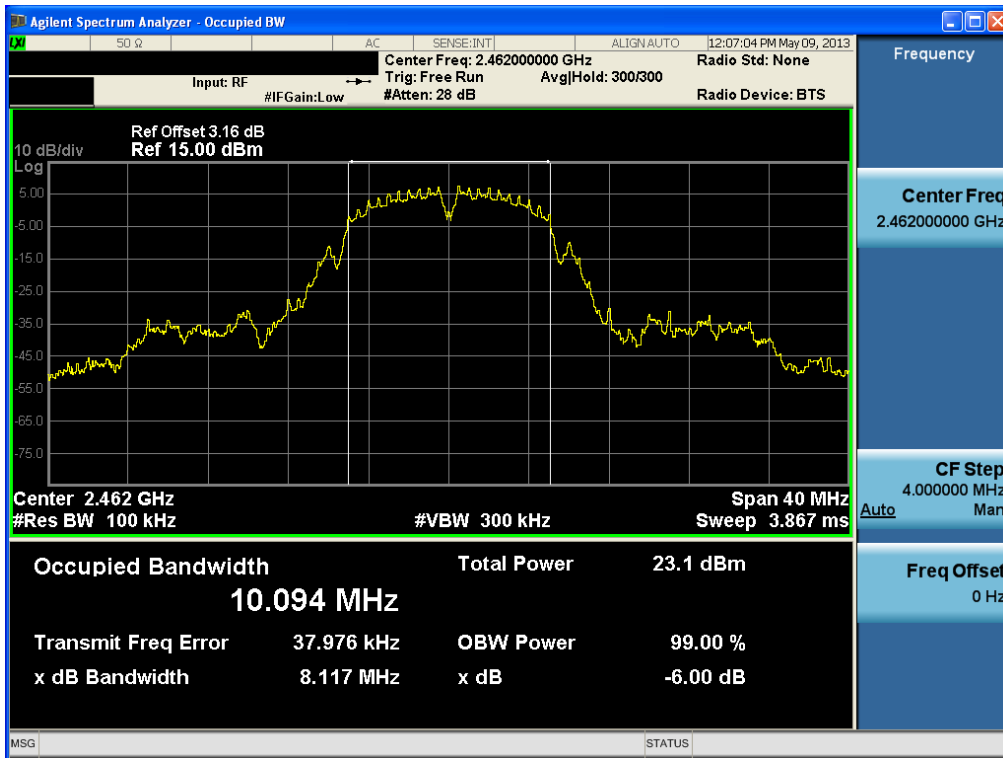
6 dB Bandwidth

Test Mode: Chain 0 & 802.11b & 1Mbps & 2437M Hz



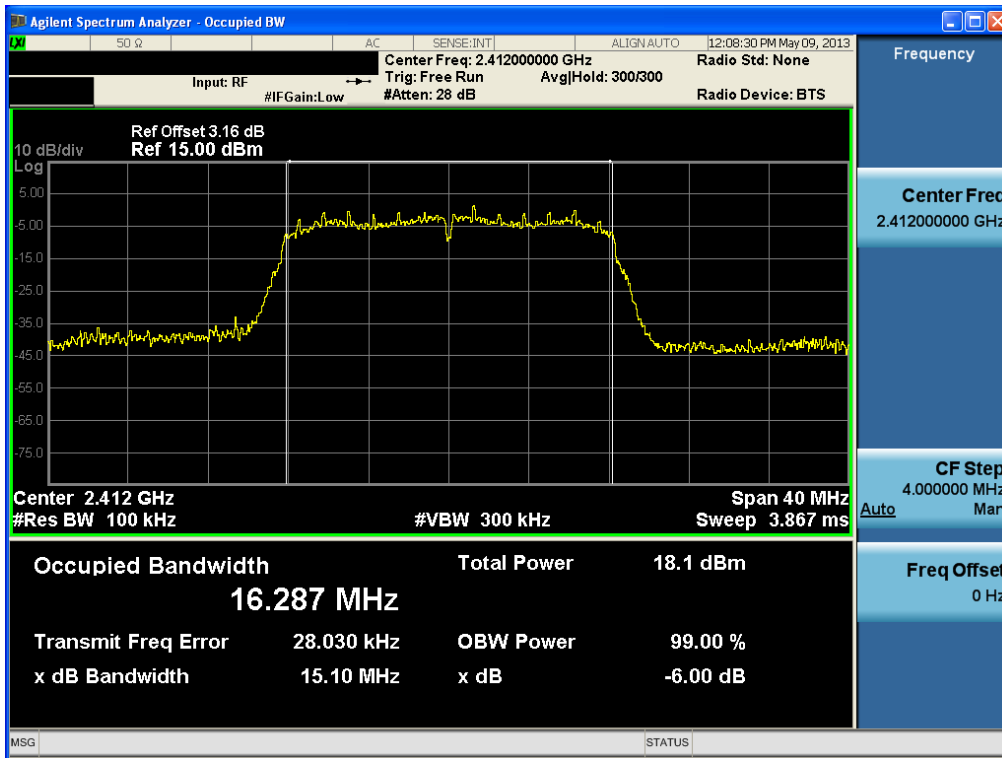
6 dB Bandwidth

Test Mode: Chain 0 & 802.11b & 1Mbps & 2462MHz



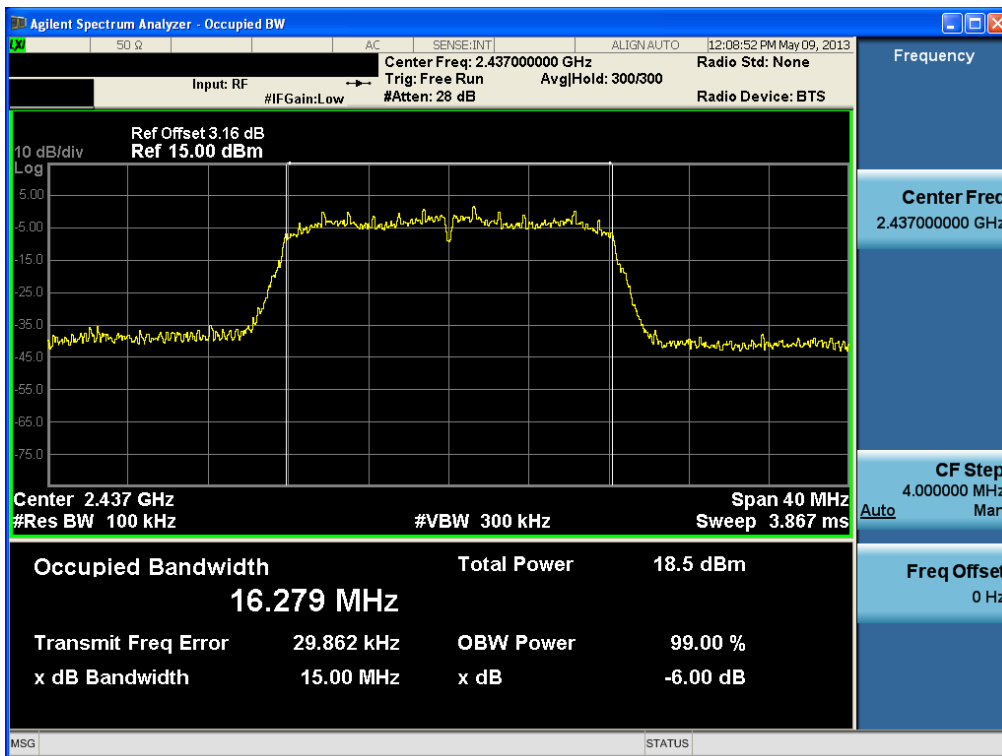
6 dB Bandwidth

Test Mode: Chain 0 & 802.11g & 6Mbps & 2412M Hz



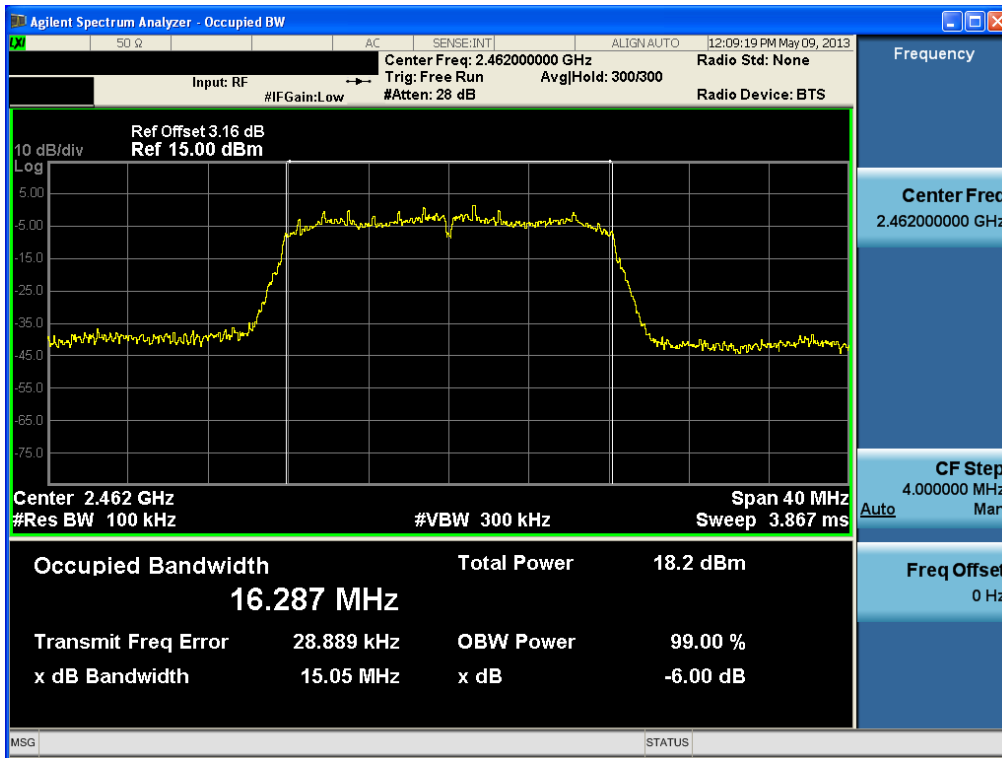
6 dB Bandwidth

Test Mode: Chain 0 & 802.11g & 6Mbps & 2437M Hz



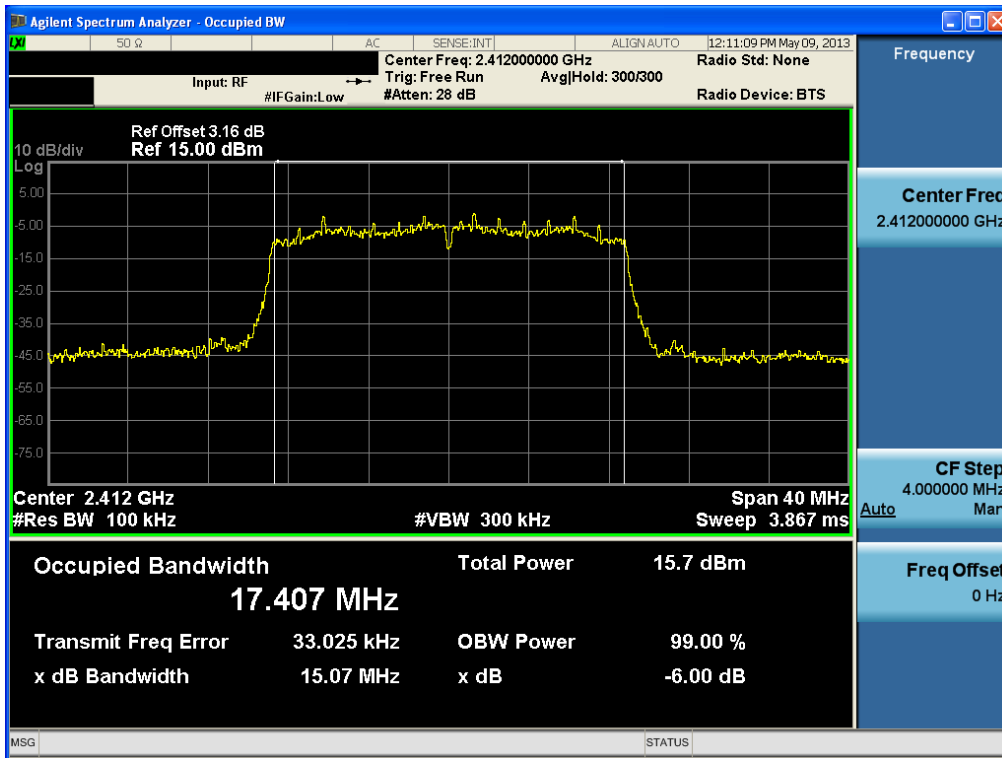
6 dB Bandwidth

Test Mode: Chain 0 & 802.11g & 6Mbps & 2462M Hz



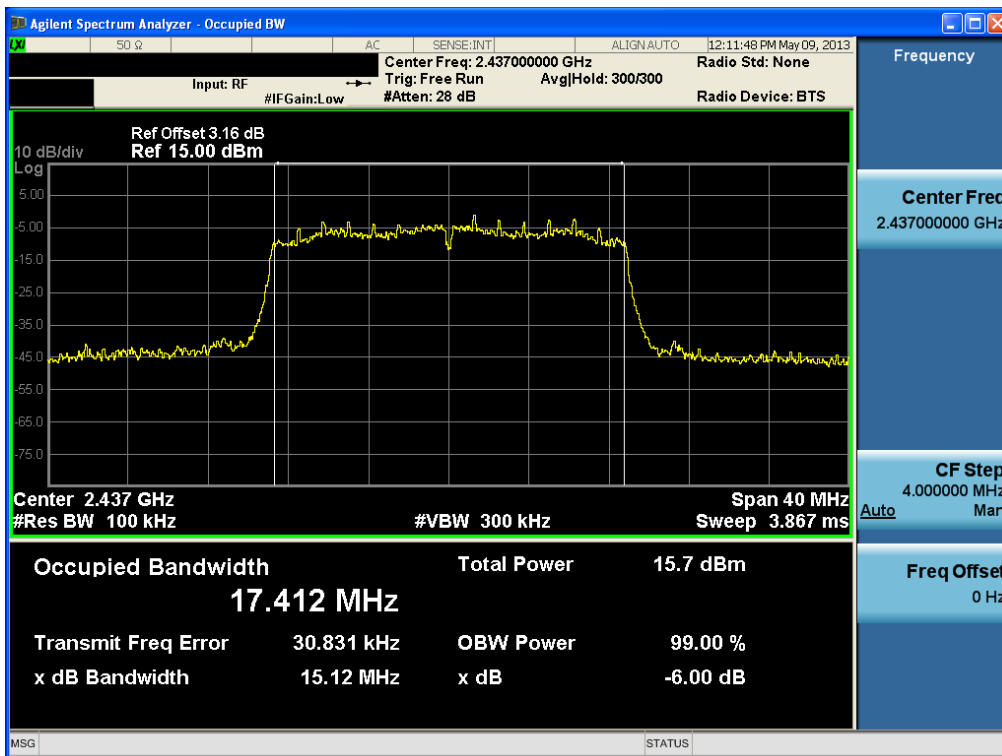
6 dB Bandwidth

Test Mode: Chain 0 & 802.11n HT20 & MCS 8 & 2412M Hz

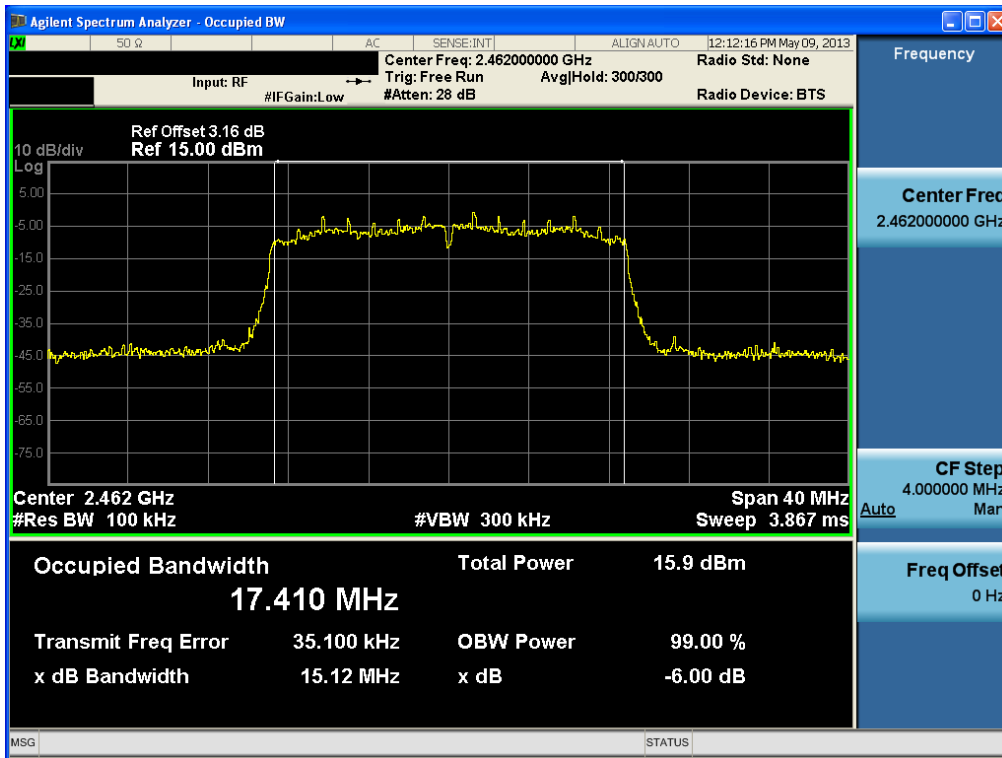


6 dB Bandwidth

Test Mode: Chain 0 & 802.11n HT20 & MCS 8 & 2437M Hz

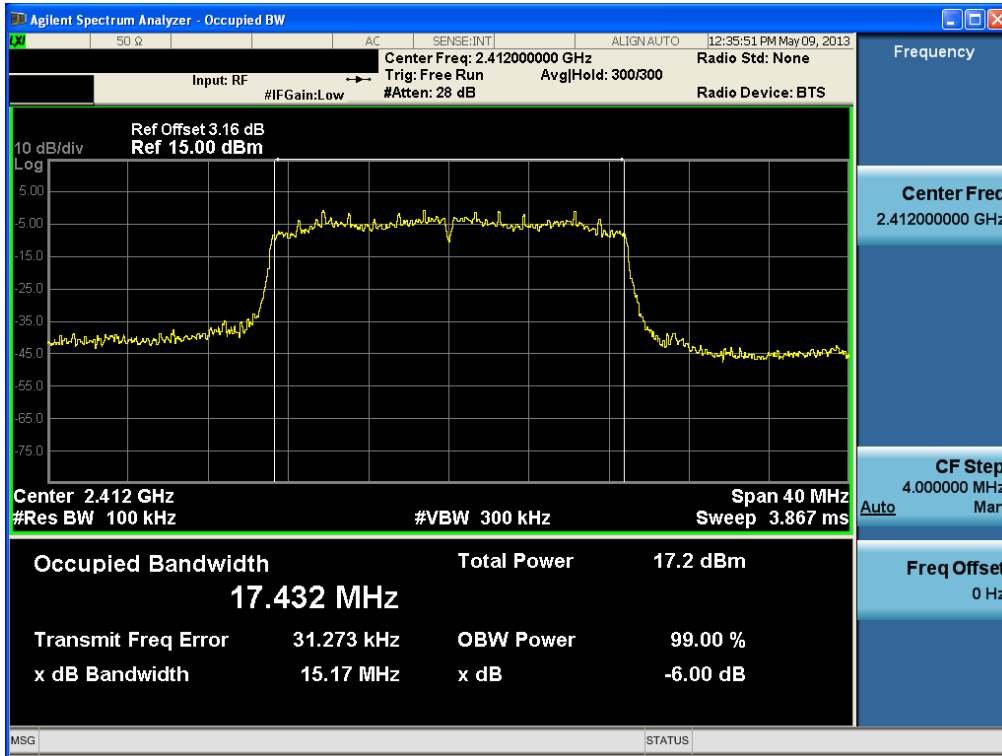


6 dB Bandwidth Test Mode: Chain 0 & 802.11n HT20 & MCS 8 & 2462M Hz



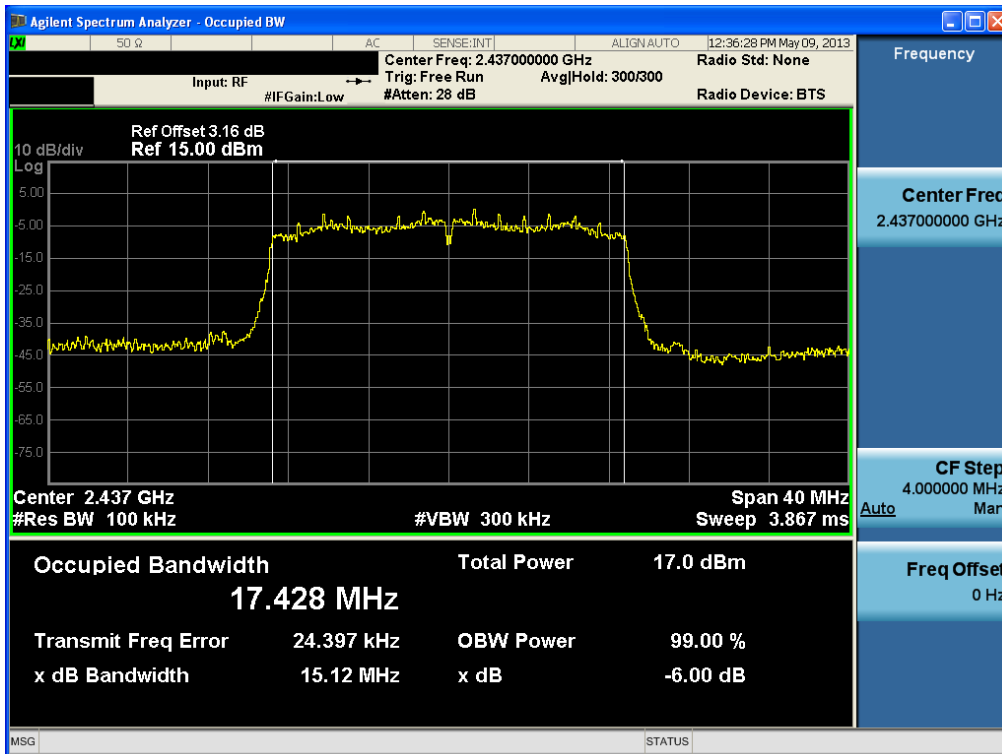
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT20 & MCS 8 & 2412M Hz

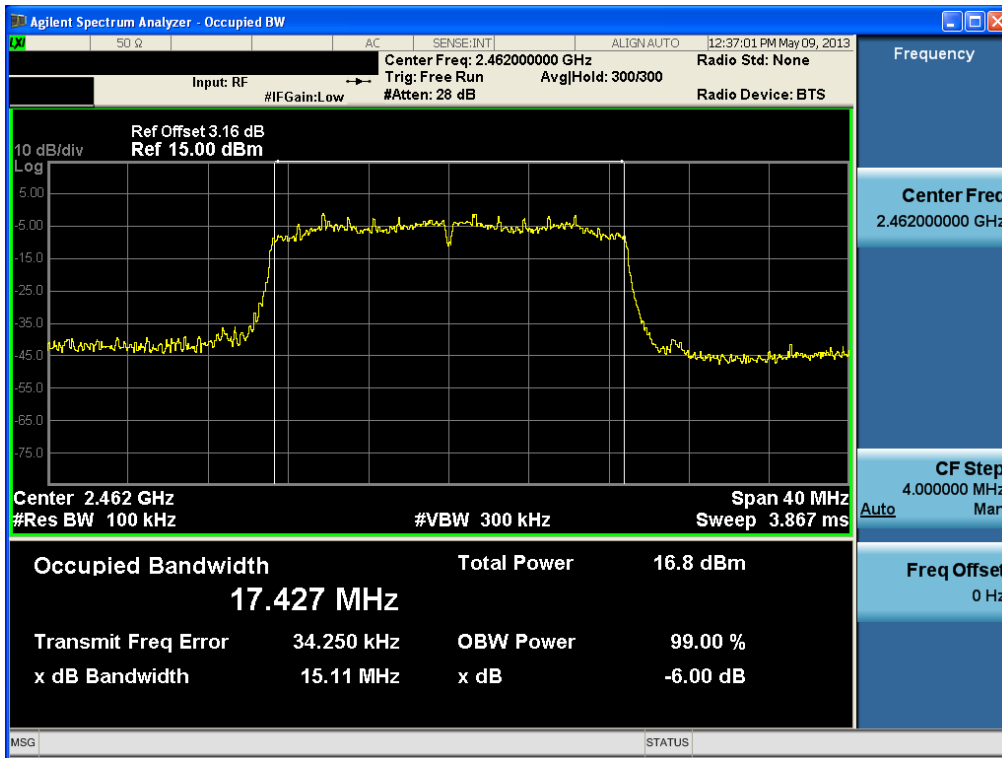


6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT20 & MCS 8 & 2437M Hz

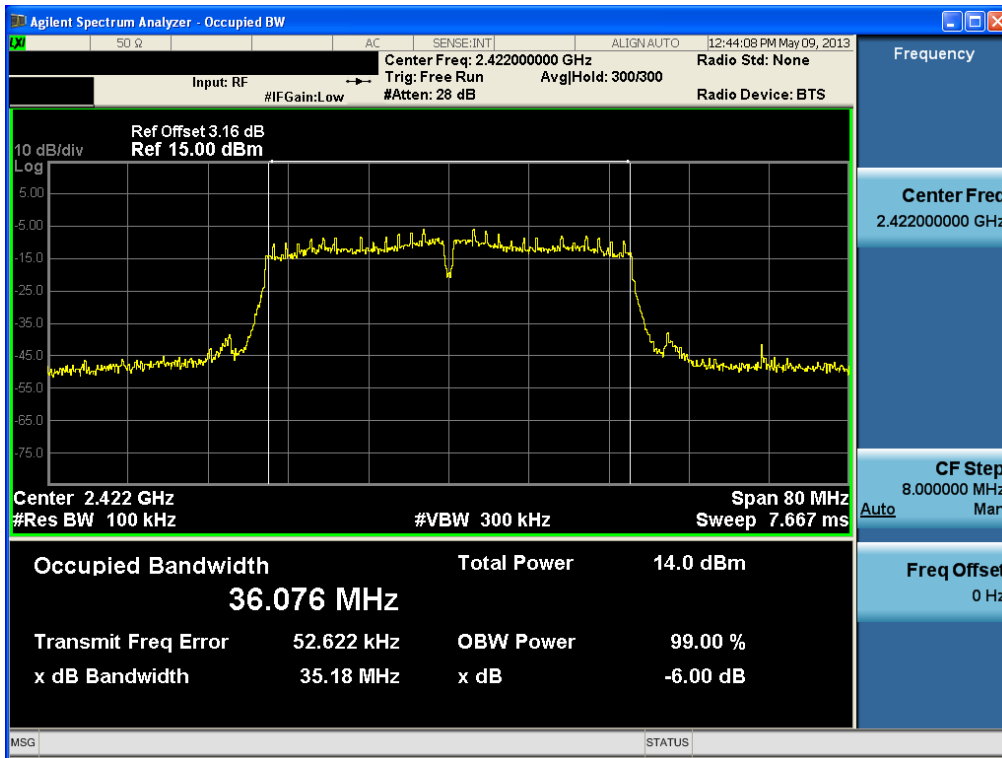


6 dB Bandwidth Test Mode: Chain 1 & 802.11n HT20 & MCS 8 & 2462MHz



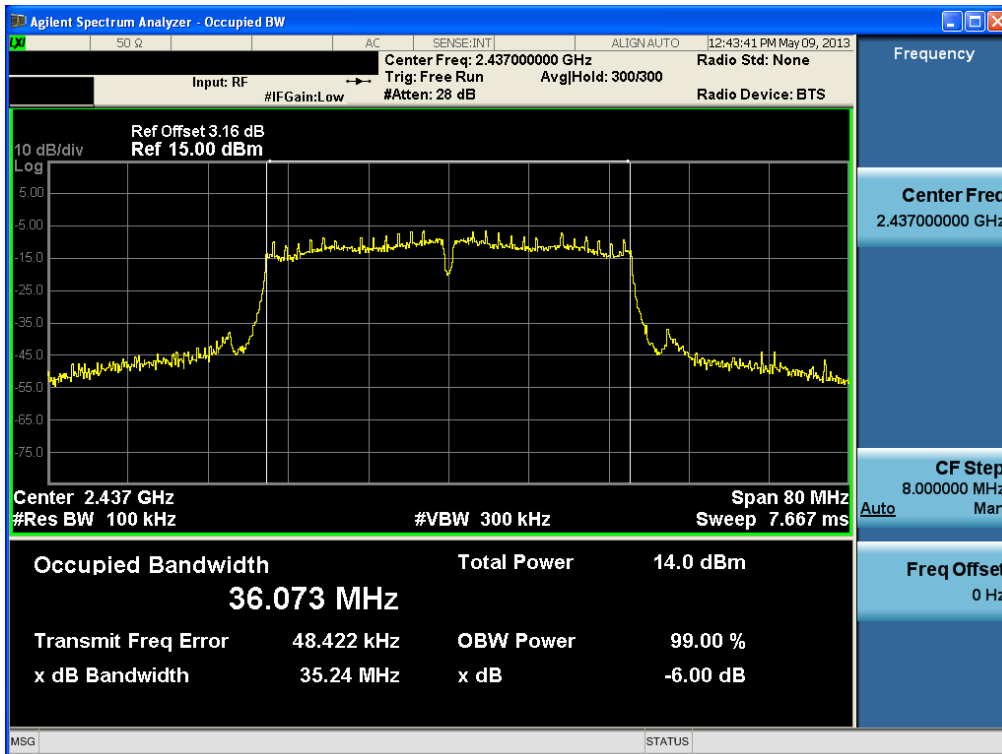
6 dB Bandwidth

Test Mode: Chain 0 & 802.11n HT40 & MCS 8 & 2 422MHz

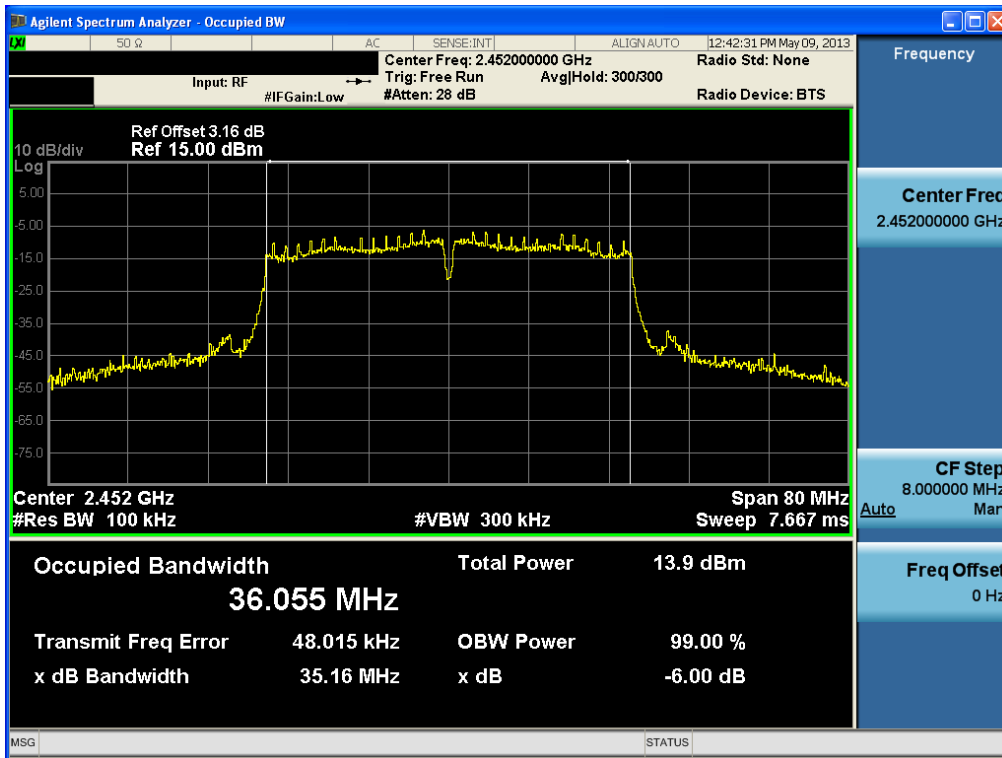


6 dB Bandwidth

Test Mode: Chain 0 & 802.11n HT40 & MCS 8 & 2437M Hz

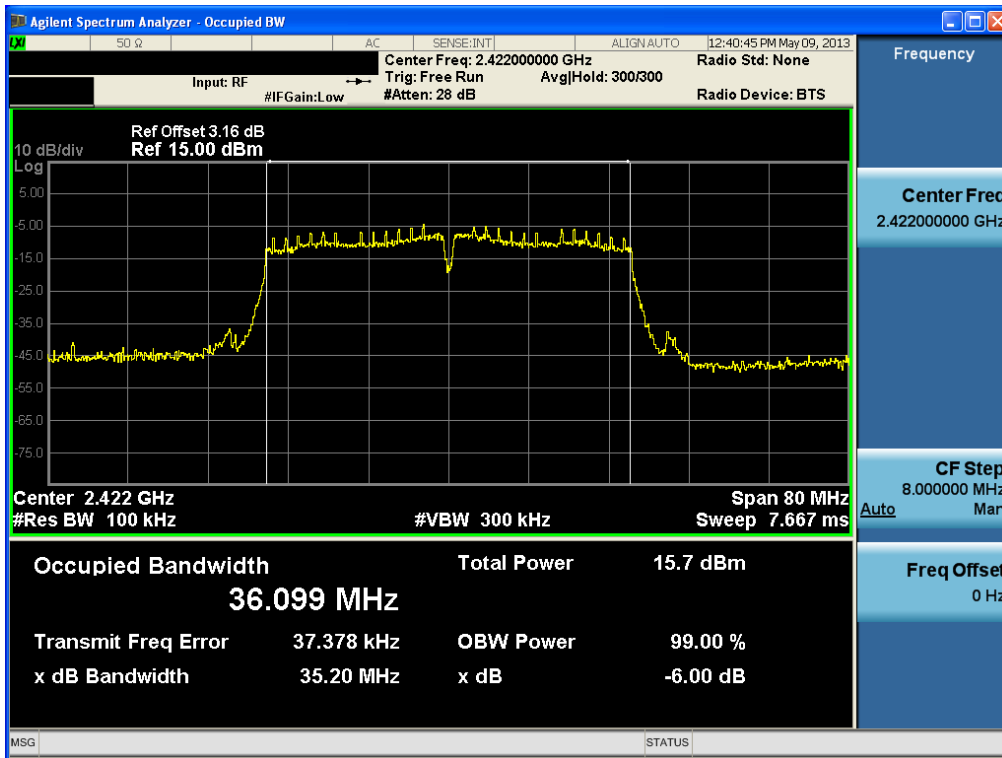


6 dB Bandwidth Test Mode: Chain 0 & 802.11n HT40 & MCS 8 & 2 452MHz



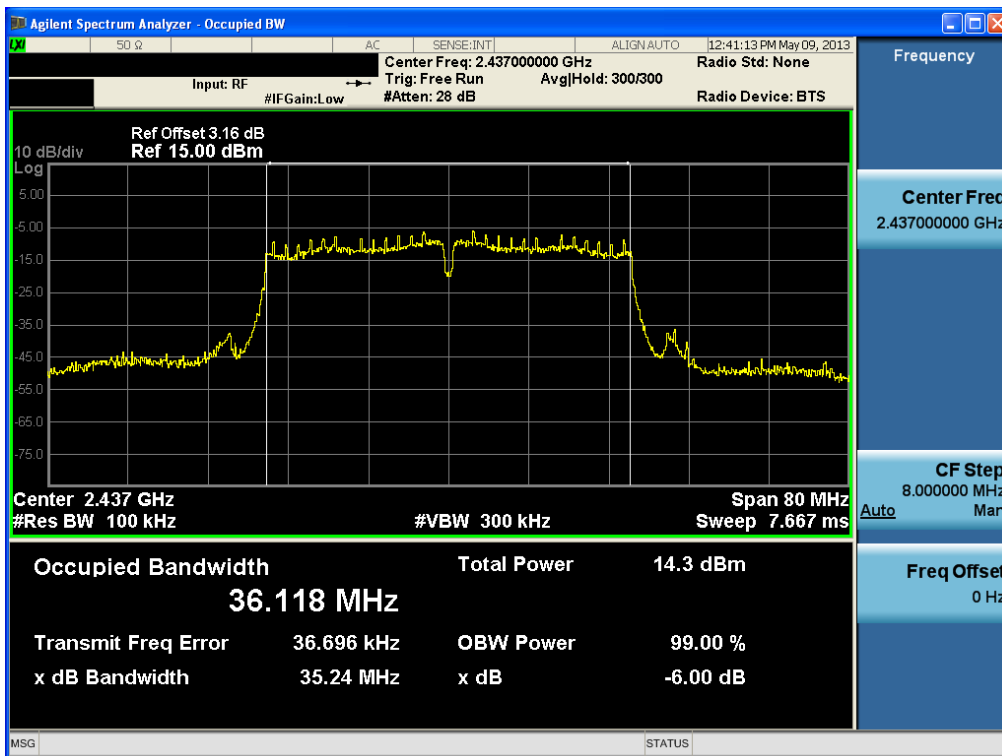
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT40 & MCS 8 & 2 422MHz

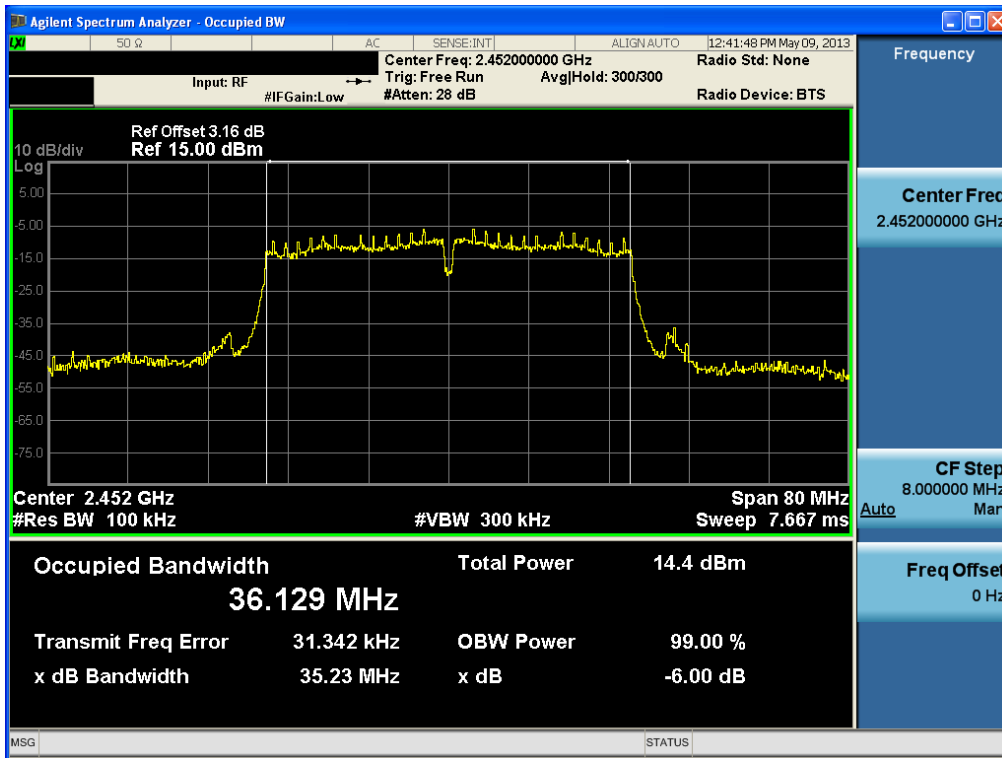


6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT40 & MCS 8 & 2437M Hz



6 dB Bandwidth Test Mode: Chain 1 & 802.11n HT40 & MCS 8 & 2 452MHz

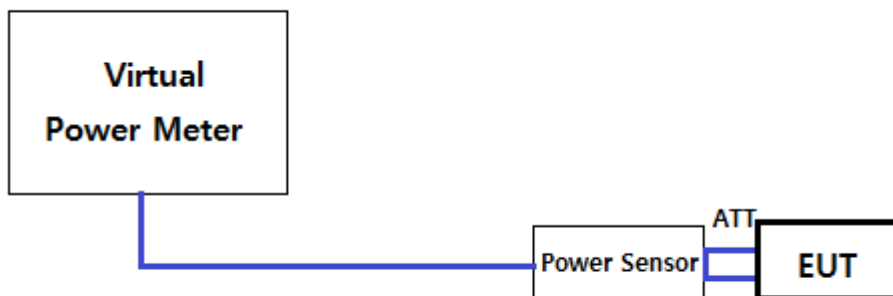


8.2 Maximum Peak Conducted Output Power

Test Requirements and limit, §15.247(b)& RSS-210 [A8.4]

The maximum permissible conducted output power is **1 Watt**.

■ TEST CONFIGURATION



■ TEST PROCEDURE

A transmitter antenna terminal of EUT is connected to the input of a power sensor using an appropriate attenuator and the total path loss between EUT and a Power Sensor was corrected on the final measurement data using a power meter’s internal function.

Measurements are made with a broadband power meter capable of making peak and average measurements while the EUT is operating in transmission mode at the appropriate frequencies.

Note1 : Tests were performed all possible data rates and the worst case data were reported.

Note2 : The directional antenna gains for MIMO with correlated signals.

Band	Chain 0 [dBi]	Chain 1 [dBi]	Directional Gain for correlated signals [dBi]
2.4GHz	5.00	5.00	8.01 > 6.00

Note : Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}]$ dBi for correlated signals

■ Calculation of limit

The limit shall be reduced by the amount in dB that the directional gain of the antenna of the antenna exceeds 6dBi.

For limit of 802.11n(HT20/HT40), the calculated limit is 27.99dBm.

$$30\text{dBm} - (8.01\text{dBi} - 6.00\text{dBi}) = 27.99\text{dBm}$$

■ **TEST RESULTS: Comply**

▪ **Single transmitting data**

Mode	Data Rate	Frequency [MHz]	Test Result			
			Chain 0		Chain 1	
			[dBm]	[W]	[dBm]	[W]
802.11b	1 Mbps	2412	19.71	0.094	-	-
		2437	19.66	0.092	-	-
		2462	19.59	0.091	-	-
802.11g	6 Mbps	2412	23.59	0.229	-	-
		2437	23.53	0.225	-	-
		2462	23.33	0.215	-	-

▪ **Multiple transmitting data**

Mode	Data Rate	Frequency [MHz]	Test Result			
			Chain 0 [dBm]	Chain 1 [dBm]	Aggregate Power ^{Note1}	
					[dBm]	[W]
802.11n HT20	MCS 8	2412	20.92	22.18	24.61	0.28879
		2437	21.22	21.68	24.47	0.27967
		2462	21.00	21.84	24.45	0.27865
802.11n HT40	MCS 8	2422	17.25	20.53	22.20	0.16607
		2437	17.40	19.88	21.82	0.15223
		2452	17.19	19.64	21.60	0.14441

Note1: Aggregate power = $10 \log(10^{\frac{\text{chain0}}{10}} + 10^{\frac{\text{chain1}}{10}})$

8.3 Maximum Power Spectral Density

Test requirements and limit, §15.247(e) & RSS-210[A8.2]

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard –specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz band segment within the fundamental EBW during any time interval of continuous transmission.

■ TEST CONFIGURATION

Refer to the APPENDIX I.

■ TEST PROCEDURE:

The Measurement Procedure **Method PKPSD of KDB558074** is used.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to **1.5 times** the DTS bandwidth.
3. Set the RBW to: **3 kHz ≤ RBW ≤ 100 kHz**.
4. Set the VBW ≥ **3 x RBW**.
5. Detector = **peak**.
6. Sweep time = **auto couple**.
7. Trace mode = **max hold**.
8. Allow trace to fully stabilize.
9. Use the **peak marker function** to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

■ Calculation of limit

The limit shall be reduced by the amount in dB that the directional gain of the antenna of the antenna exceeds 6dBi.

For limit of 802.11n(HT20/HT40), the calculated limit is 5.99dBm.

$$8\text{dBm} - (8.01\text{dBi} - 6.00\text{dBi}) = 5.99\text{dBm}$$

■ **TEST RESULTS: Comply**

▪ **Single transmitting data**

Mode	Data Rate	Frequency [MHz]	RBW	PPSD	
				Chain 0	Chain 1
				[dBm]	[dBm]
802.11b	1 Mbps	2412	3 kHz	-6.65	-
		2437	3 kHz	-6.53	-
		2462	3 kHz	-6.46	-
802.11g	6 Mbps	2412	3 kHz	-11.60	-
		2437	3 kHz	-13.74	-
		2462	3 kHz	-12.23	-

▪ **Multiple transmitting data**

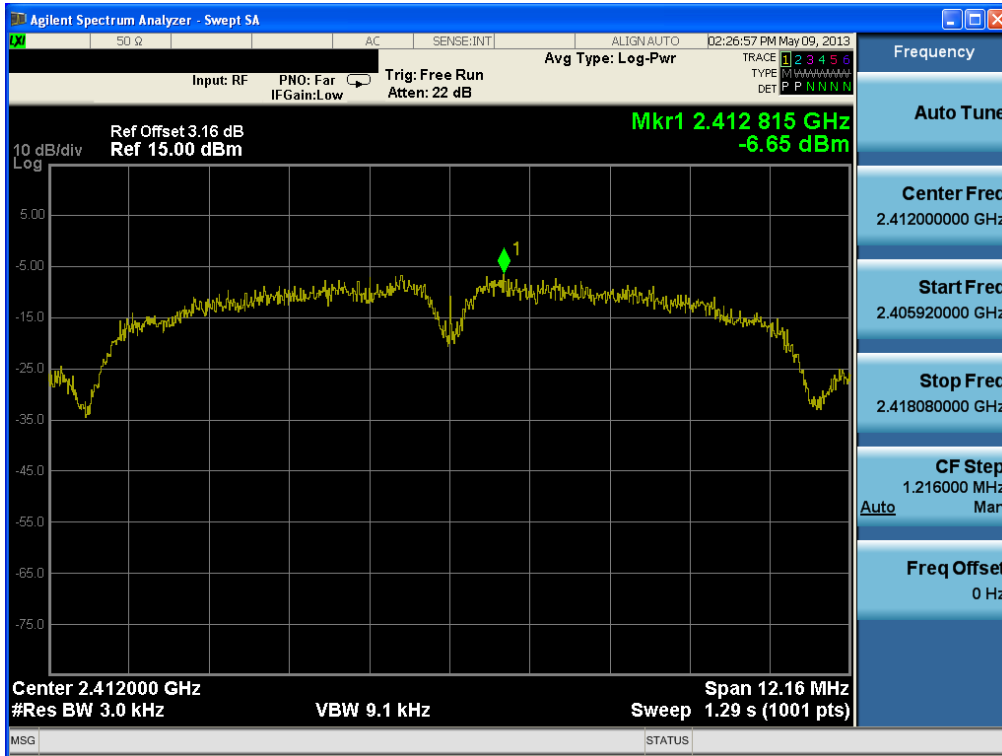
Mode	Data Rate	Frequency [MHz]	RBW	PPSD		
				Chain 0	Chain 1	Aggregate
				[dBm]	[dBm]	PPSD ^{Note1} [dBm]
802.11n HT20	MCS 8	2412	3 kHz	-15.90	-14.37	-12.06
		2437	3 kHz	-15.41	-13.72	-11.47
		2462	3 kHz	-14.57	-13.78	-11.15
802.11n HT40	MCS 8	2422	3 kHz	-19.54	-19.73	-16.62
		2437	3 kHz	-19.32	-19.78	-16.53
		2452	3 kHz	-19.49	-20.60	-17.00

Note1: Aggregate PPSD = $10 \log \left(10^{\frac{\text{chain0}}{10}} + 10^{\frac{\text{chain1}}{10}} \right)$

RESULT PLOTS

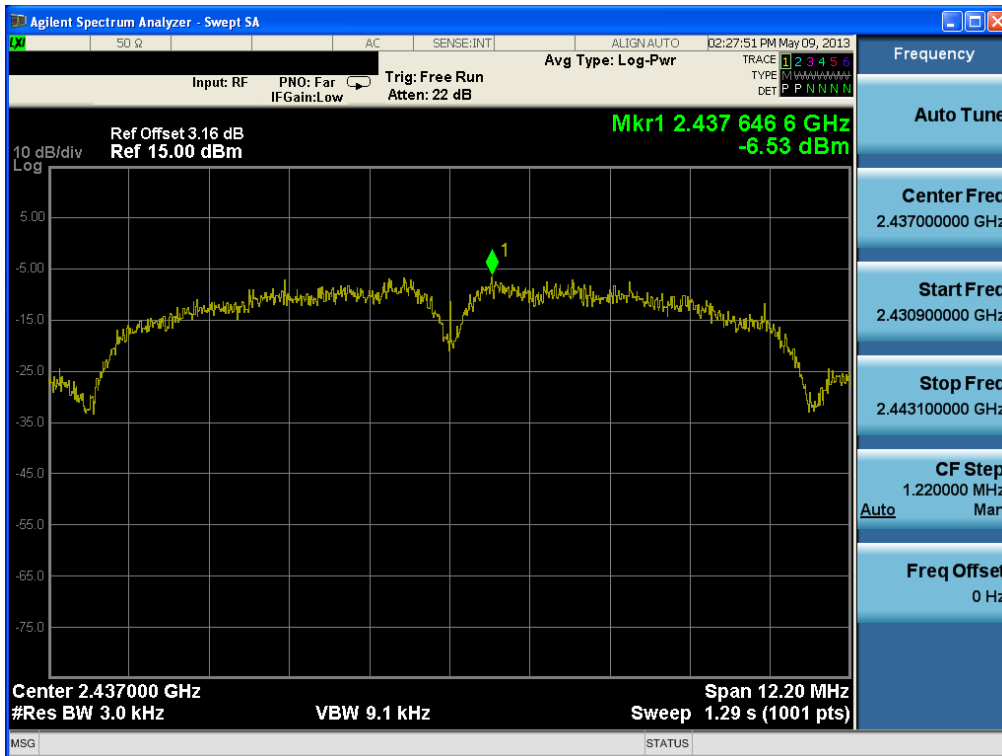
Maximum PPSD

Test Mode: Chain 0 & 802.11b & 1Mbps & 2412MHz



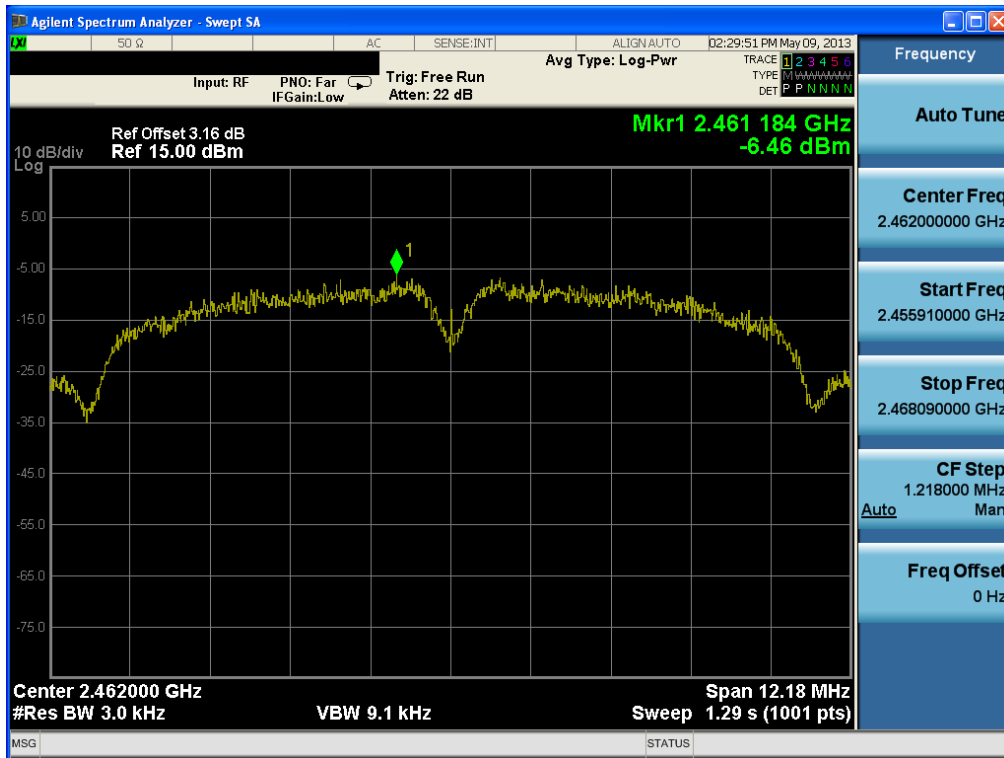
Maximum PPSD

Test Mode: Chain 0 & 802.11b & 1Mbps & 2437M Hz



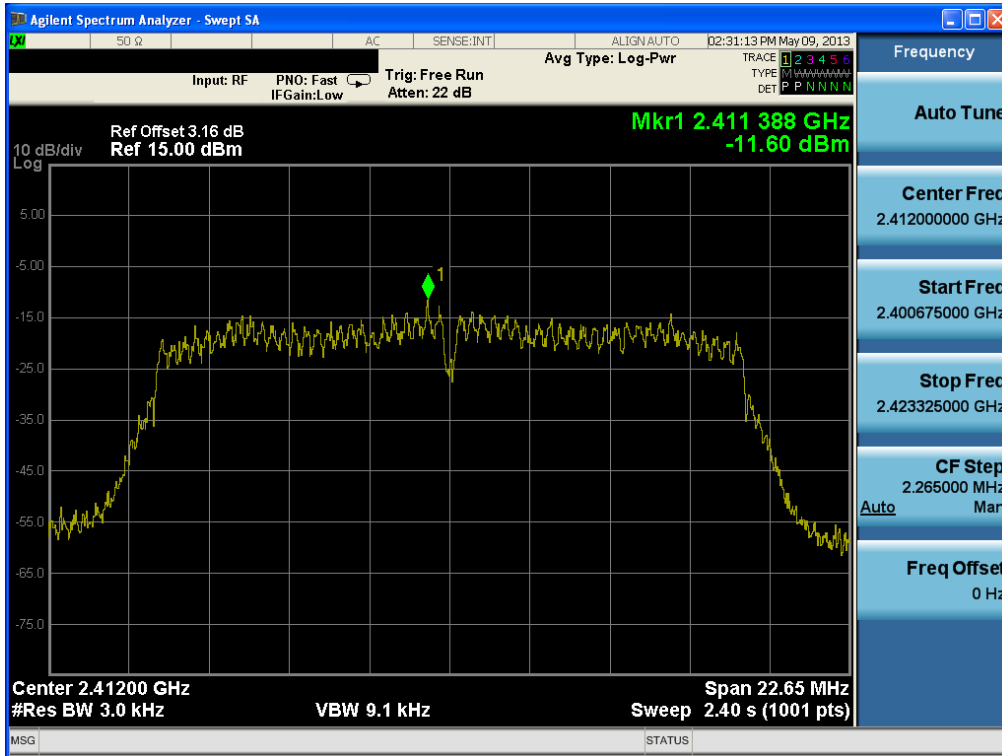
Maximum PPSD

Test Mode: Chain 0 & 802.11b & 1Mbps & 2462MHz



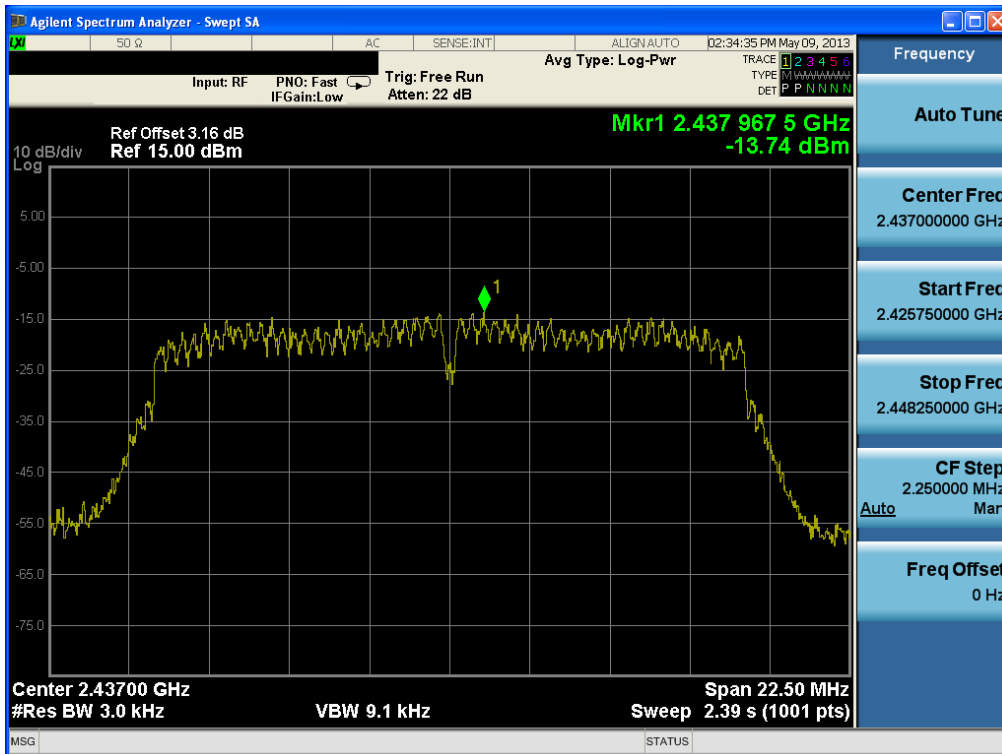
Maximum PPSD

Test Mode: Chain 0 & 802.11g & 6Mbps & 2412M Hz



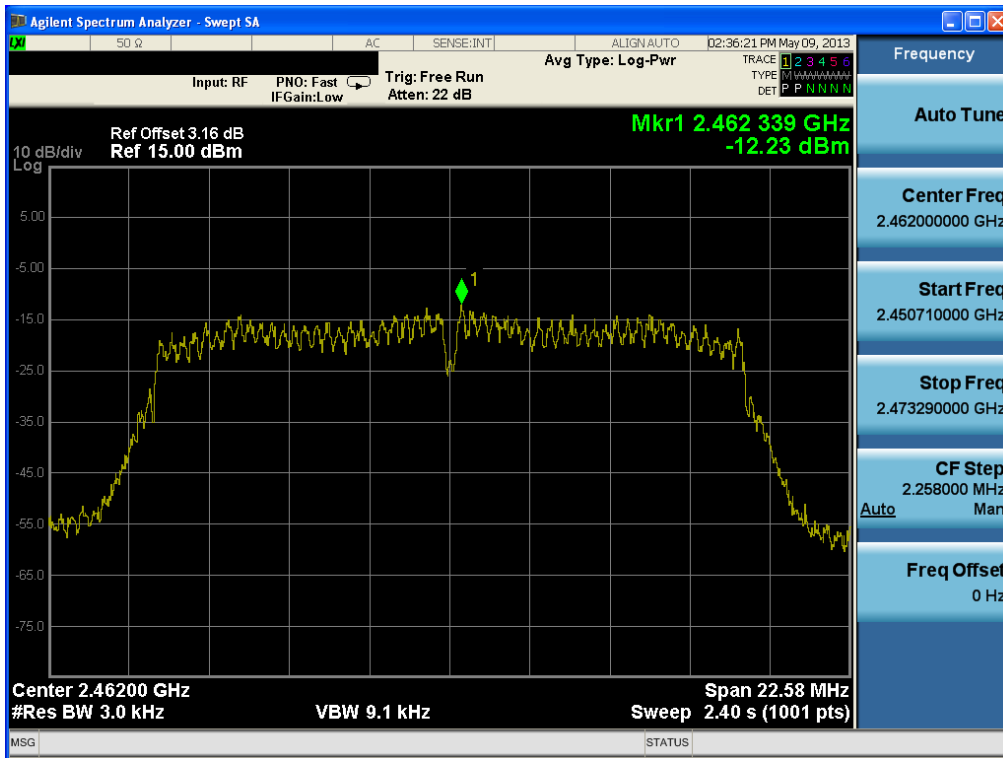
Maximum PPSD

Test Mode: Chain 0 & 802.11g & 6Mbps & 2437M Hz



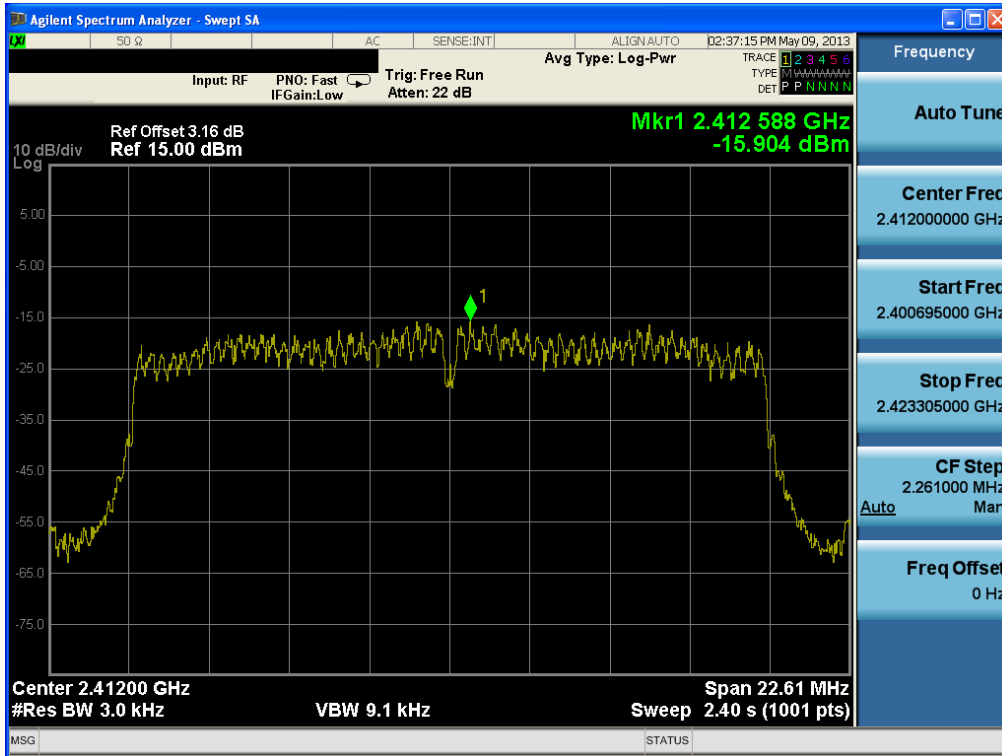
Maximum PPSD

Test Mode: Chain 0 & 802.11g & 6Mbps & 2462M Hz



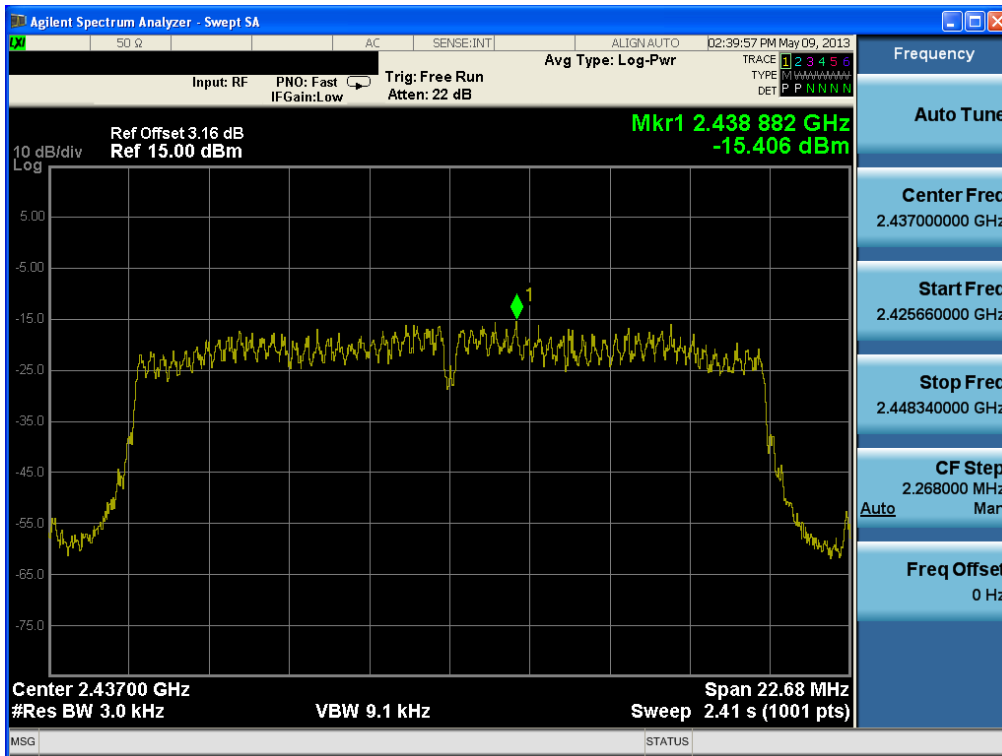
Maximum PPSD

Test Mode: Chain 0 & 802.11n HT20 & MCS 8 & 2412M Hz

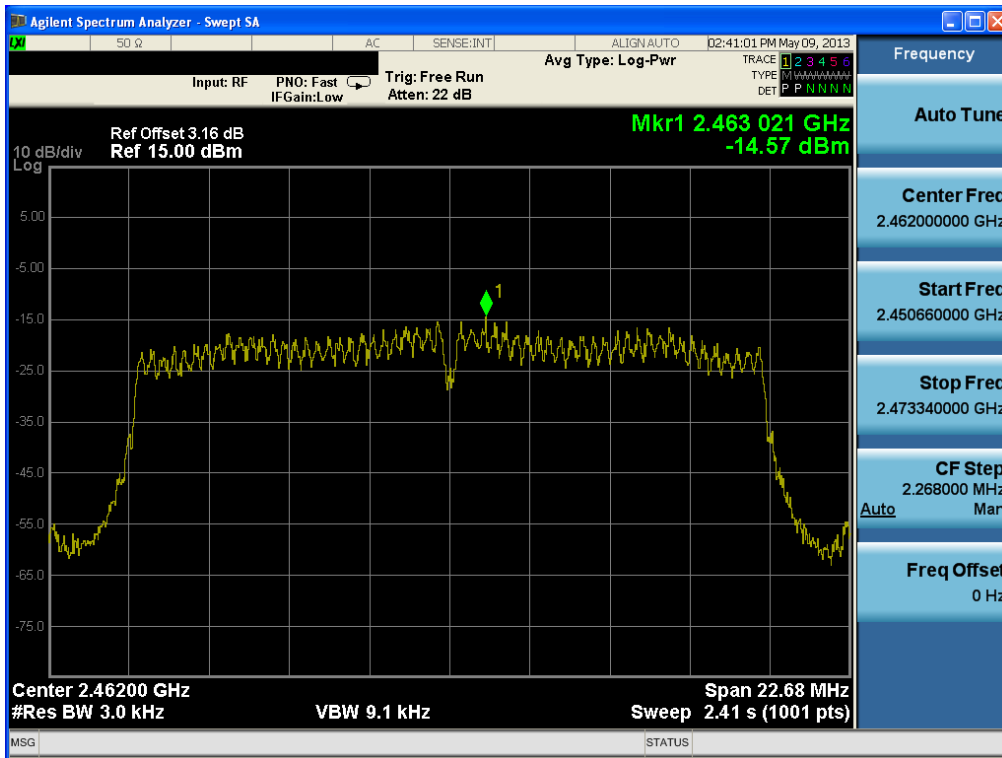


Maximum PPSD

Test Mode: Chain 0 & 802.11n HT20 & MCS 8 & 2437M Hz

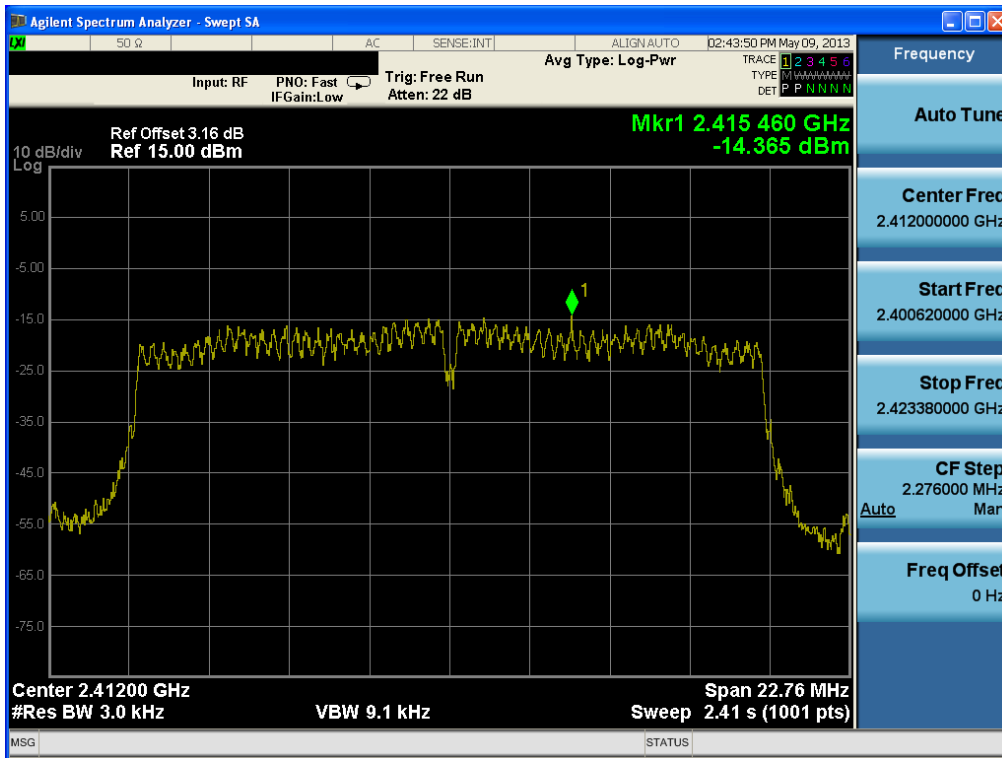


Maximum PPSD Test Mode: Chain 0 & 802.11n HT20 & MCS 8 & 2462M Hz



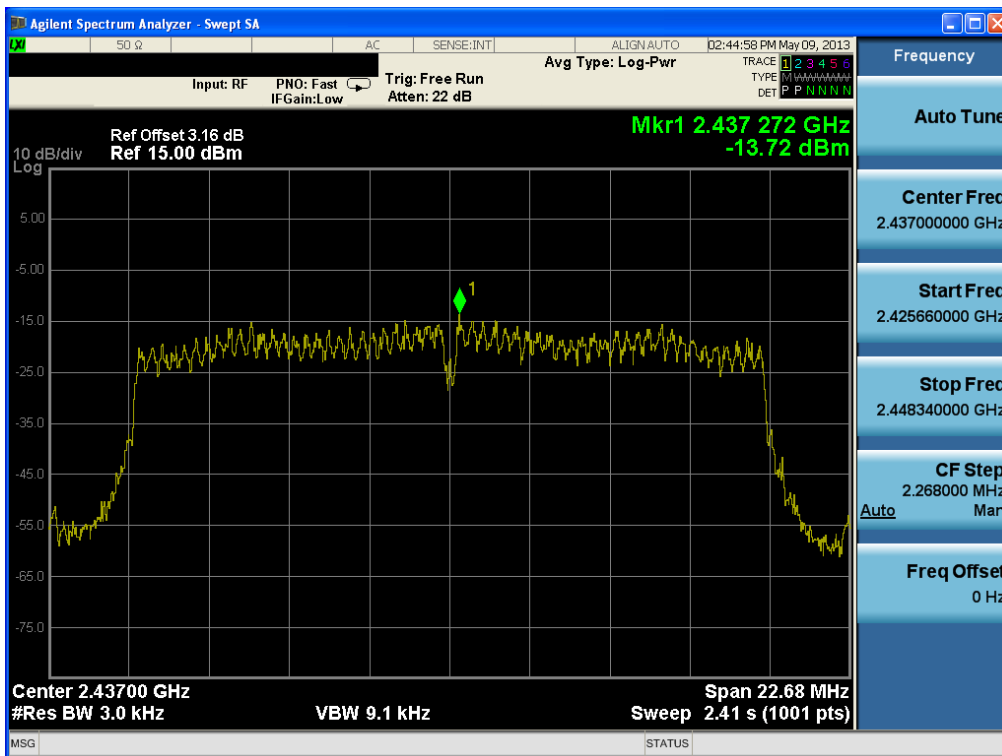
Maximum PPSD

Test Mode: Chain 1 & 802.11n HT20 & MCS 8 & 2412M Hz

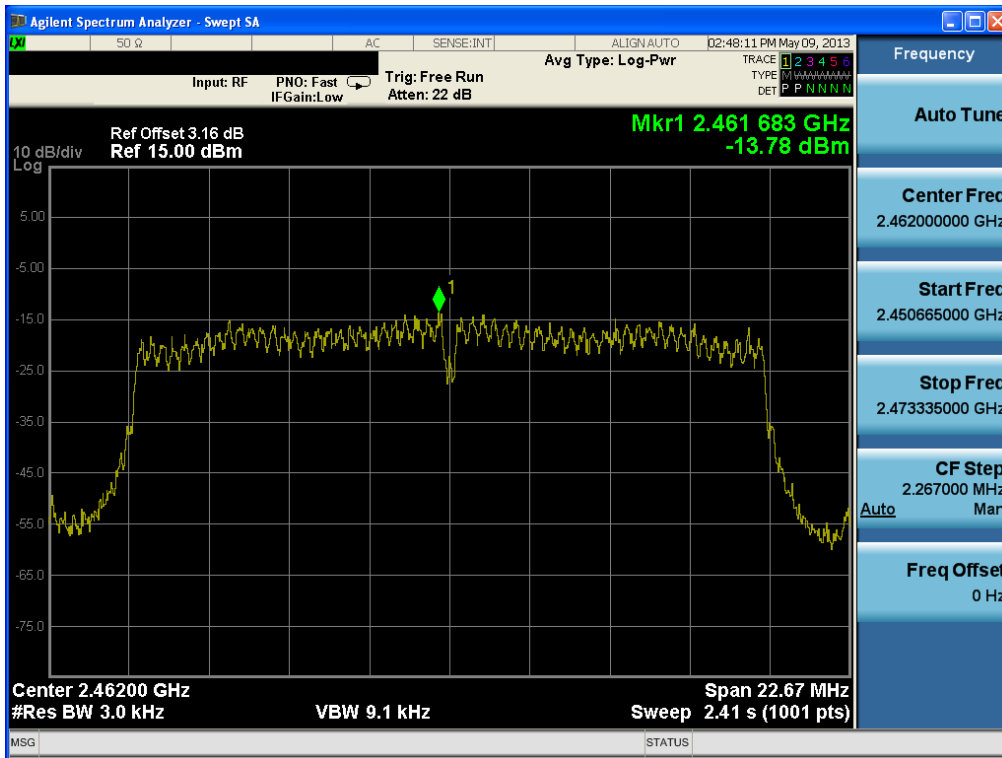


Maximum PPSD

Test Mode: Chain 1 & 802.11n HT20 & MCS 8 & 2437M Hz

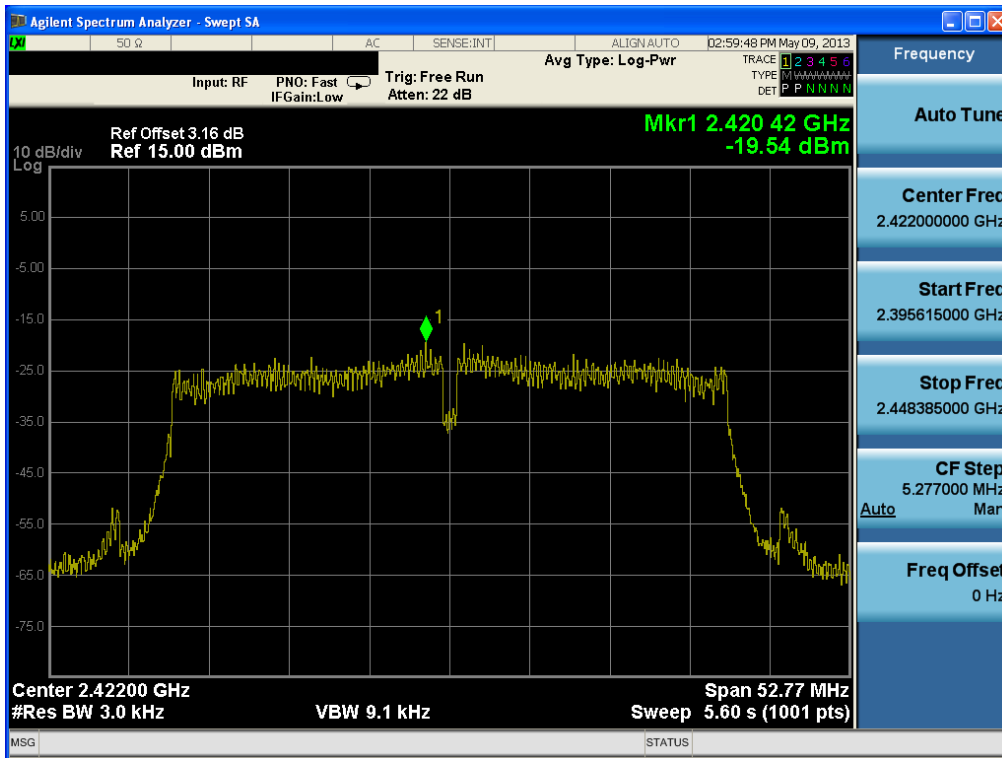


Maximum PPSD Test Mode: Chain 1 & 802.11n HT20 & MCS 8 & 2462M Hz



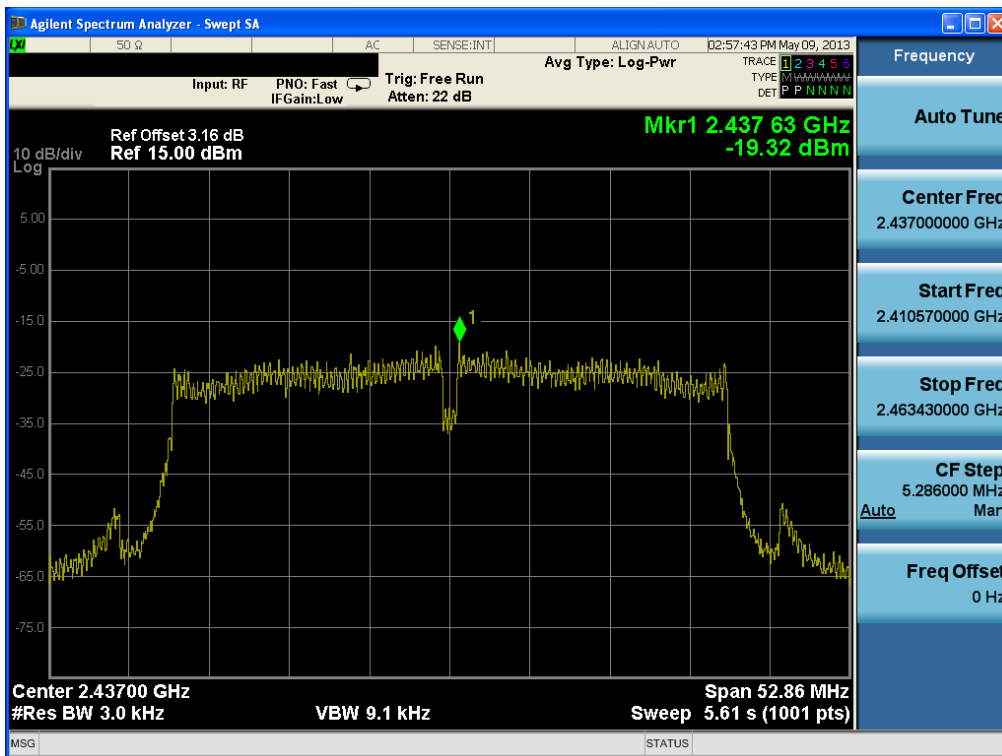
Maximum PPSD

Test Mode: Chain 0 & 802.11n HT40 & MCS 8 & 2 422MHz

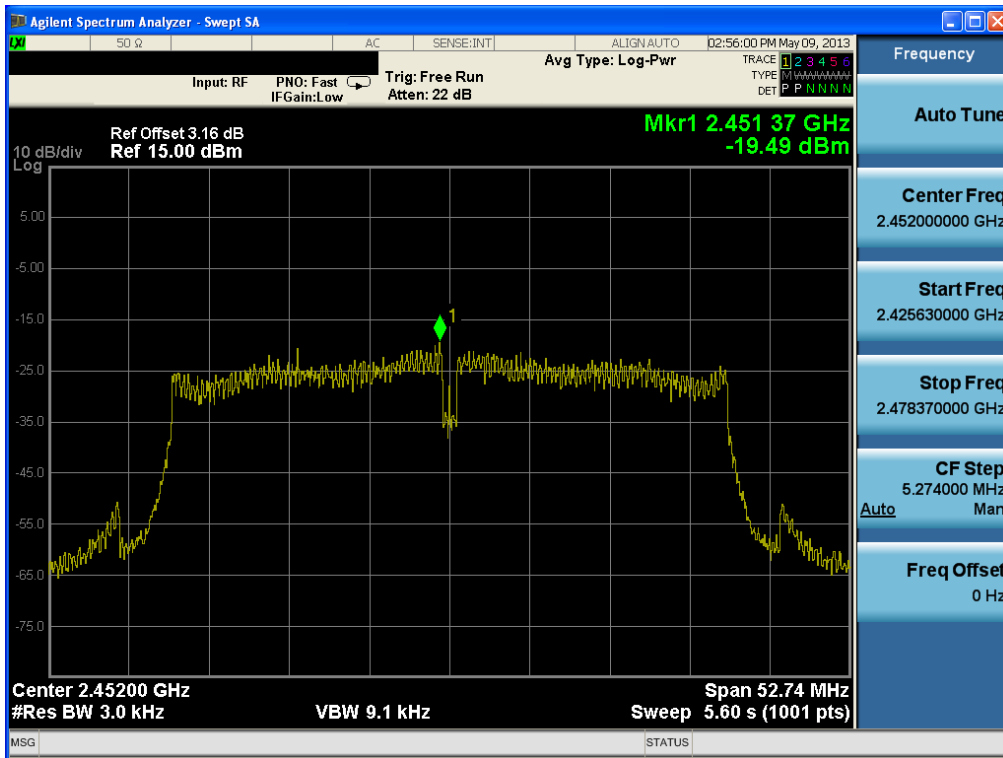


Maximum PPSD

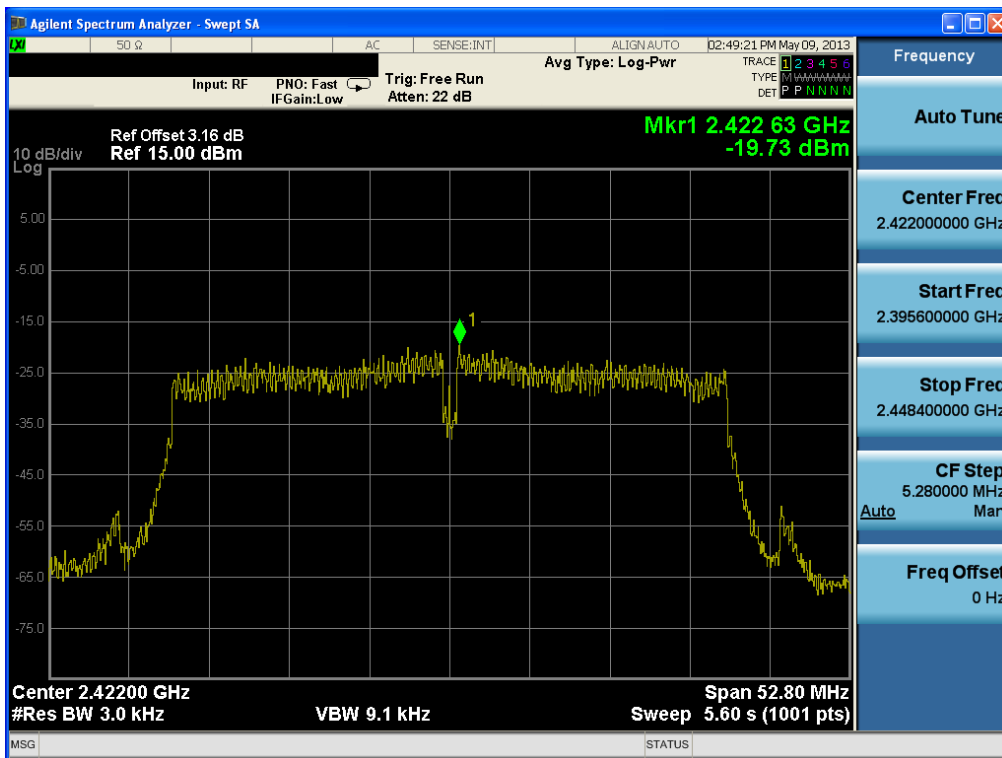
Test Mode: Chain 0 & 802.11n HT40 & MCS 8 & 2437MHz



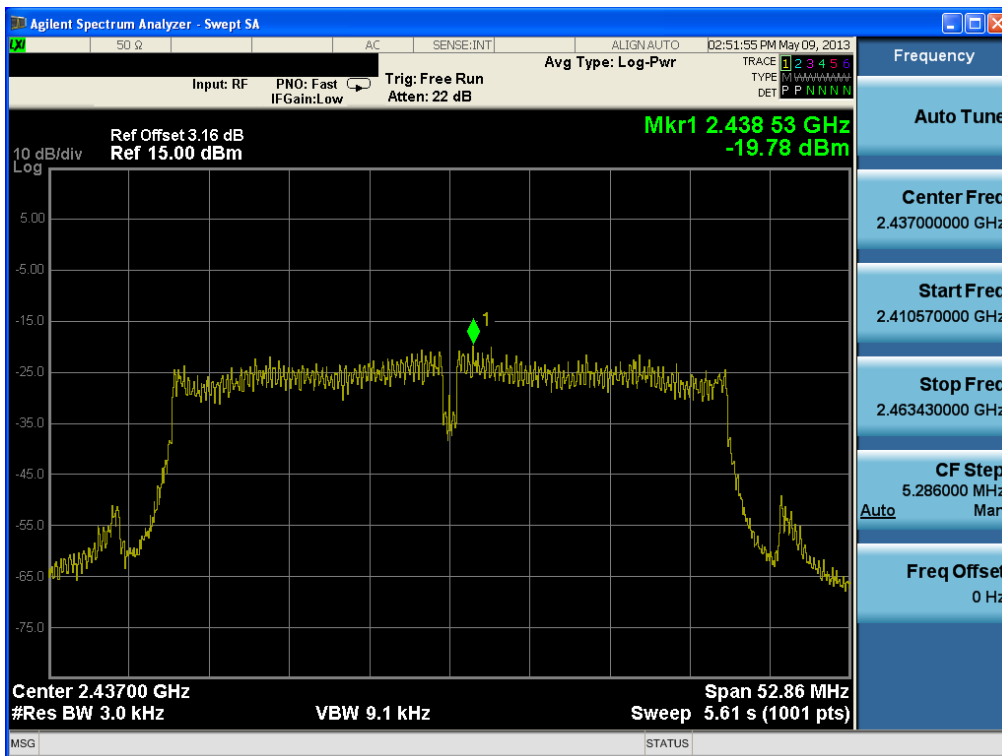
Maximum PPSD Test Mode: Chain 0 & 802.11n HT40 & MCS 8 & 2 452MHz



Maximum PPSD Test Mode: Chain 1 & 802.11n HT40 & MCS 8 & 2 422MHz



Maximum PPSD Test Mode: Chain 1 & 802.11n HT40 & MCS 8 & 2437M Hz



Maximum PPSD Test Mode: Chain 1 & 802.11n HT40 & MCS 8 & 2 452MHz

